

**City of Durham
Transportation Division**

March 16, 2010

Memorandum

To: Durham City-County Planning Department
From: Bill Judge P.E., Transportation Engineer IV
Subject: NC 751 Colvard Farms Mixed-Use Development (Z0800003) Revised Traffic Impact Analysis

The City-County Unified Development Ordinance requires that a Traffic Impact Analysis (TIA) study be prepared for proposed development plans estimated to generate 150 or more vehicle trips during the peak hour. The proposed NC 751 Colvard Farms Mixed-Use Development is located on the west side of NC 751 near the NC 751/Fayetteville Road intersection, north of the Chatham County line. The proposed development entails approximately 150 acres of wooded land and would include a maximum of 1,179 residential units (625 apartments, 432 townhomes, and 122 single-family homes), 300,000 square feet of office space, 300,000 square feet of retail space, and civic space that includes a 450-student public elementary school and a 550-student public middle school. The proposed development could also include a fire station, EMS station, or other civic uses located directly across from the development on the east side of NC 751. The development is expected to be completed in 2015. The proposed development is projected to generate 24,648 external daily trips, with 2,057 occurring during the A.M. peak hour (1,148 entering and 909 exiting) and 1,984 occurring during the P.M. peak hour (870 entering and 1,114 exiting). The access to the development is proposed via four access points along NC 751, of which three are full movement driveways (Site Access #2, #3 and #4), and one right-in/ right-out driveway (Site Access #5).

The TIA study was prepared for the proposed mixed-use development by Martin Alexiou Bryson in February, 2008. A revised TIA study was prepared for the proposed mixed-use development by MAB in July 2008, with addendums in October 2008, January 2009, and November 2009. The revised TIA was prepared in response to multiple proposed land use changes.

Study Area

The TIA study includes analysis of twenty-two (22) intersections in the vicinity of the proposed site listed below:

Signalized

- NC 751 and Autopark Boulevard;
- NC 751 and I-40 WB Ramps;
- NC 751 and I-40 EB Ramps;
- NC 751 and Renaissance Parkway;
- NC 751 and Stagecoach Rd (SR 1107);
- NC 751 and Fayetteville Road (SR 1118)/ Site Access #4;
- Fayetteville Road (SR 1118) and Renaissance Parkway/ Old Village Way.

Unsignalized

- NC 751 and Massey Chapel Road;
- Stagecoach Road (SR 1107) and Farrington Road (SR 1110);
- NC 751 and Chancellor's Ridge Drive;
- NC 751 and Student Place/ Site Access #2;
- NC 751 and Higher Learning Drive;
- NC 751 and Colvard Farms Road (eliminated in the Build scenario);
- NC 751 and Site Access #3/ Proposed Fire-EMS Facility;
- NC 751 and Site Access #5;
- NC 751 and O'Kelly Chapel Road (SR 1731);
- Fayetteville Road (SR 1118) and Massey Chapel Road (SR 1106) (north);
- Fayetteville Road (SR 1118) and Massey Chapel Road (SR 1106) (south);
- Fayetteville Road (SR 1118) and Scott King Road (SR 1103);
- Massey Chapel Road/Barbee Road (SR 1106) and Herndon Road (SR 1104);
- Barbee Road (SR 1106) and Grandale Road;
- Scott King Road (SR 1103) and Herndon Road (SR 1104).

Traffic Data Collection

The A.M. and P.M. peak hour intersection turning movement counts were taken between the hours of 7am to 9am and 4pm to 6pm during the months of November 2007, January 2008, February 2008, and July 2008. The counts were collected over multiple months due to changes with the development plan that created the need for an expanded study area.

Trip Generation

Site generated traffic for the proposed development was computed based on ITE's *Trip Generation Manual, 7th Edition, 2003*. The TIA used the following ITE trip generation uses for the proposed development:

| USE | UNITS | ITE CODE |
|--------------------------------|--------------|-------------|
| Apartments | 625 units | 220 |
| Single Family Detached Housing | 122 units | 210 |
| Residential Townhomes | 432 units | 230 |
| General Office | 300,000 s.f. | 710 |
| Supermarket | 55,000 s.f. | 850 |
| General Retail | 98,000 s.f. | 820 |
| Specialty Retail | 147,000 s.f. | 814 |
| Public Elementary School | 450 students | NCDOT rates |
| Public Middle School | 550 students | NCDOT rates |

These proposed uses would generate a total of 30,089 daily trips of which 2,295 trips would occur during the AM peak hour and 2,805 trips would occur during the PM peak hour. Due to the mixed use nature of the project, some of these trips will be captured internally. Based on ITE guidelines related to internal capture for mixed use developments, the site trips were reduced by 18.1% for daily trips, 10.4% for AM peak hour trips, and 16.3% for PM peak hour trips. In addition, the PM peak hour trips were adjusted by 13.0% for pass-by trips.

The final adjusted external trips for the proposed site resulted in 24,648 daily trips, with 2,057 occurring during the AM peak hour and 1,984 occurring during the PM peak hour.

Trip Distribution and Assignment

The trips were distributed based on existing traffic patterns with consideration given to the location of various land uses within the development. The TIA used different trip distributions for different land uses. The following table provides the distribution pattern used in the analysis:

| Approach To Study Area | Land Use | | | |
|--|-------------|--------|--------|--------|
| | Residential | Retail | Office | School |
| From the North on NC 751 | 9% | 9% | 9% | 6% |
| From the East on Autopark Boulevard | 1% | 1% | 1% | 2% |
| From the East on I-40 | 15% | 10% | 15% | 8% |
| From the West on I-40 | 25% | 12% | 21% | 10% |
| From the North on Fayetteville Road | 11% | 10% | 10% | 12% |
| From the East on Old Village Way | 1% | 0% | 0% | 0% |
| From the East on Barbee Road | 1% | 1% | 2% | 3% |
| From the South on Grandale Road | 1% | 1% | 1% | 2% |
| From the North on Herndon Road | 1% | 2% | 1% | 5% |
| From the North on Farrington Road | 1% | 1% | 0% | 1% |
| From the South on Farrington Road | 9% | 8% | 4% | 9% |
| From the East on Student Place | 0% | 2% | 1% | 1% |
| From the East on Scott King Road | 1% | 1% | 1% | 5% |
| From the Southeast on O'Kelly Chapel Road | 3% | 7% | 5% | 3% |
| From the South on NC 751 | 10% | 17% | 15% | 2% |
| From the East on Chancellor's Ridge Drive | 0% | 2% | 2% | 2% |
| From the East on Higher Learning Drive | 0% | 0% | 0% | 1% |
| Driveways along Massey Chapel Road between NC 751 and Fayetteville Road | 0% | 4% | 3% | 5% |
| Driveways along Renaissance Parkway between NC 751 and Fayetteville Road | 5% | 3% | 2% | 3% |
| Driveways along Fayetteville Road between Massey Chapel Road and Scott King Road | 1% | 2% | 2% | 5% |
| Driveways along Scott King Road between Fayetteville Road and Herndon Road | 3% | 3% | 3% | 6% |
| Driveways along Herndon Road between Barbee Road and Scott King Road | 2% | 4% | 2% | 9% |

Approved Developments and Background Growth

For background traffic growth rate, variable rates between 0% and 2% were applied to the existing traffic counts depending on traffic volumes at specific intersection. For those intersections, where traffic growth due to approved developments exceeded the 3% annual growth rate, a 0% growth rate was applied for background traffic. For those intersections, where traffic growth due to approved developments came just below the 3% annual growth rate, a 1% growth rate was applied for background traffic. Similarly, for those intersections where traffic growth due to approved developments came close to 1.5% per year, a 2% growth rate was applied for background traffic. This procedure has been discussed with the City of Durham and documented in the Memorandum of Understanding (Appendix F) and on Page 16 of the original TIA study.

The TIA used the traffic volume projections from the following approved developments:

- Jordan at Southpoint: The development is located south of Scott King Road and east of NC 751. The development consists of 218 single family homes and is expected to generate approximately 2,130 daily trips with 163 trips in the AM peak hour and 216 trips in the PM peak hour. The development is scheduled for completion in year 2011;
- Renaissance Village Update: This development is located in the northeast quadrant of the NC 751 and Renaissance Parkway intersection. It includes a 63 room hotel, a drive-in bank with 4 windows, and a 35,000 square-foot specialty retail center. It is expected to generate 337 trips in the PM peak hour. The development is scheduled for completion in year 2009;
- Park at Southpoint: This development is located on NC 751 just north of I-40. It includes 336,031 square-feet of auto dealerships, a 15,000 square-foot automobile parts/service center, car wash, and a convenience market with 12 fueling stations. It is expected to generate 17,714 daily trips with 895 trips in the AM peak hour and 1,184 trips in the PM peak hour. The development is scheduled for completion in year 2015;
- The Hills at Southpoint: This development is located on the east side of Fayetteville Road approximately 1.5 miles south of I-40. The development includes 280 luxury homes. Because no TIA was available for this development, trips were generated in accordance with standard *ITE* rates.

Transportation Improvement Plan (TIP) Roadway Improvements

NCDOT TIP Project # SF-4908I proposes to construct a traffic signal and southbound left-turn lane on NC 751 at O'Kelly Road. The project is currently under construction with a scheduled completion date of April 30, 2010.

Capacity Analysis

Capacity analyses were performed using Synchro 7.0 for the AM and PM peak hours for the following scenarios:

- Existing (2007 and 2008) conditions;
- No-Build (2016) conditions (2007-2008 Existing + Background Growth + Approved Development Traffic);
- Build (2016) conditions (2016 No-Build + Site Traffic);
- Build with Improvements (2016) conditions (2016 Build + proposed roadway improvements).

NC 751 and Autopark Boulevard

The following table summarizes the Level of Service (LOS) for this signalized intersection.

| Scenario | AM LOS | PM LOS |
|-----------------|--------|--------|
| Existing (2008) | A | A |
| No-Build (2016) | B | B |
| Build (2016) | B | B |

The analysis indicates that the intersection will operate at acceptable levels of service for all scenarios and traffic conditions. Therefore, no improvements are required.

NC 751 and I-40 Westbound Ramps

The following table summarizes the Level of Service (LOS) for this signalized intersection.

| Scenario | AM LOS | PM LOS |
|--------------------------------|--------|--------|
| Existing (2007) | B | C |
| No-Build (2016) | C | C |
| Build (2016) | C | C |
| Build with Improvements (2016) | C | C |

The analysis indicates that all movements will operate at acceptable levels of service for all scenarios and time periods with the following improvement that are also committed to by other developments:

- Construct an additional westbound right-turn lane with 250 feet of minimum storage.

With this improvement in place, the intersection is expected to remain at a LOS C during the both the AM and PM peak hour with improved queuing and reduced delays.

NC 751 and I-40 Eastbound Ramps

The following table summarizes the LOS for this signalized intersection.

| Scenario | AM LOS | PM LOS |
|--------------------------------|--------|--------|
| Existing (2007) | B | C |
| No-Build (2016) | B | C |
| Build (2016) | B | D |
| Build with Improvements (2016) | C | D |

The analysis indicates that this location will operate at a LOS D during the PM peak hour due to the addition of site generated traffic. The TIA recommended the following improvements that are also committed to by other developments:

- Restripe the southbound approach to allow for dual left-turn lanes with 200 feet of minimum storage;
- Widen the I-40 Eastbound On-Ramp to accommodate a second receiving lane.

With these improvements in place, the intersection is expected to remain at a LOS D during the PM peak hour with improved queuing and reduced delays. The TIA noted that the 95th percentile volume has exceeded capacity, but it does not exceed the recommended storage length of 200 feet, due to upstream metering. The TIA also noted that 200 feet of storage is the maximum storage possible without major bridge widening.

To address safety issues with the heavy eastbound right-turn, NCDOT required the following improvements to prevent traffic from queuing from the eastbound off-ramp onto I-40:

- Extend the outer eastbound right-turn lane on the I-40 eastbound off-ramp to provide a minimum of 500 feet of storage.

With this additional improvement in place, the intersection is expected to remain at a LOS C during the both the AM peak hour and a LOS D during the PM peak hour with improved queuing and reduced delays.

NC 751 and Renaissance Parkway

The following table summarizes the LOS for this signalized intersection.

| Scenario | AM LOS | PM LOS |
|-----------------|----------|----------|
| Existing (2007) | B | B |
| No-Build (2016) | B | B |
| Build (2016) | B | B |

The analysis indicates that all movements will operate at acceptable levels of service for all scenarios and time periods with the following improvement:

- Extend the existing southbound through lane as a second through lane for a minimum of 1,200 feet south of the intersection with appropriate tapers.

With this improvement in place, the intersection is expected to remain at a LOS B during the both the AM and PM peak hour with improved queuing and reduced delays.

NC 751 and Massey Chapel Road

The following table summarizes the LOS and delay for this unsignalized intersection.

| Scenario | AM LOS | PM LOS |
|--------------------------------|-----------|-----------|
| Existing (2008) | E* | E* |
| No-Build (2016) | F* | F* |
| Build (2016) | F* | F* |
| Build with Improvements (2016) | F* | F* |

* Unsignalized operation, with LOS reported for the worst approach

The analysis indicates that the westbound Massey Chapel Road approach at this location will operate at a LOS F during both peak hours under future No-Build and Build conditions. To mitigate this condition, the TIA recommended the following improvement:

- Construct a westbound right-turn lane with 100 feet of minimum storage.

The westbound approach will continue to operate at a LOS F as an unsignalized intersection with the proposed improvement. Although a LOS F is undesirable at signalized intersections, a LOS F is typical at many unsignalized intersections during a peak hour until such time as a traffic signal is warranted. To address LOS concerns at this unsignalized intersection, the following additional improvement is required by the City of Durham:

- Install a traffic signal (subject to MUTCD warrants and approval by NCDOT).

NC 751 and Stagecoach Road

The following table summarizes the LOS for this signalized intersection.

| Scenario | AM LOS | PM LOS |
|--------------------------------|----------|----------|
| Existing (2007) | D | C |
| No-Build (2016) | F | E |
| Build (2016) | F | F |
| Build with Improvements (2016) | D | C |

The analysis indicates that this location will operate at a LOS F during both the AM and PM peak hours in the future Build conditions. The TIA recommended the following improvements to accommodate site traffic:

- Widen NC 751 to provide two through lanes in each direction from south of Fayetteville Road (Site Access #5) to north of Stagecoach Road. The additional southbound lane must commence a minimum of 1,000 feet north of the Stagecoach Road intersection, and the additional northbound lane must extend a minimum of 1,200 (exclusive of tapers) north of the Stagecoach Road intersection;
- Construct a northbound left-turn lane at Stagecoach Road with 400 feet of minimum storage.

With these improvements in place, the intersection operation would improve to an acceptable LOS D or better during both peak hours.

Stagecoach Road and Farrington Road

The following table summarizes the LOS for this unsignalized intersection.

| Scenario | AM LOS | PM LOS |
|---|-----------|-----------|
| Existing (2007) | F* | F* |
| No-Build (2016) | F* | F* |
| Build (2016) | F* | F* |
| Build with traffic signal only (2016) | D | F |
| Build with signal and turn lanes (2016) | B | B |

* Unsignalized operation, with LOS reported for the worst approach

The analysis indicates that the westbound Stagecoach Road approach at this location will operate at a LOS F during both peak hours under future No-Build and Build conditions. The vehicles on the westbound approach would experience an average delay of 365 seconds during the morning commute and 695 seconds during the evening commute with No-Build traffic. With site traffic added, delays on the same approach would increase to 640 seconds in the morning and unusually high (unpredictable) in the evening. To mitigate this condition, the TIA recommended the following improvements:

- Install a three-phase signal (subject to MUTCD warrants and approval by NCDOT).

With the installation of a traffic signal and no additional improvements, the intersection would operate at a LOS D in the AM peak hour and a LOS F in the PM peak hour. To address LOS and safety concerns at this intersection, the following additional improvement are required by the City of Durham:

- Construct a westbound right-turn lane with 100 feet of minimum storage;
- Construct a northbound right-turn lane with 100 feet of minimum storage.

With these additional improvements, the intersection would operate at an acceptable LOS B for both the AM and PM peak hour. The TIA did not recommend these additional improvements due to right-of-way and constructability concerns as the adjacent property is owned by the United States Army Corps of Engineers. However, these improvements are needed to provide an acceptable LOS at this intersection and are therefore required.

NC 751 and Chancellor's Ridge Drive

The following table summarizes the LOS and delay for this unsignalized intersection.

| Scenario | AM LOS | PM LOS |
|--------------------------------|-----------|-----------|
| Existing (2008) | C* | B* |
| No-Build (2016) | C* | B* |
| Build (2016) | F* | F* |
| Build with Improvements (2016) | F* | E* |

* Unsignalized operation, with LOS reported for the worst approach

The analysis indicates that the westbound Chancellors Ridge Drive approach at this location will operate at a LOS F during the AM peak hour and LOS E during the PM peak hour under future Build conditions. Although a LOS F is undesirable at signalized intersections, a LOS F is typical at many unsignalized intersections during a peak hour until such time as a traffic signal is warranted.

NC 751 and Student Place/ Site Access #2 (full access)

The following table summarizes the LOS for this unsignalized intersection.

| Scenario | AM LOS | PM LOS |
|--------------------------------|--------|--------|
| Existing (2008) | C* | A* |
| No-Build (2016) | C* | B* |
| Build (2016) | F* | F* |
| Build with Improvements (2016) | C | B |

* Unsignalized operation, with LOS reported for the worst approach

The analysis indicates that the eastbound Student Place approach will operate at a LOS C or better with No-Build traffic volumes. With site traffic added, the eastbound and westbound approaches will both operate at a LOS F with very high delays. The TIA recommended the following improvements to mitigate congestion:

- Widen NC 751 to provide one additional through lane in each direction;
- Construct a northbound left-turn lane on NC 751 with 200 feet of minimum storage;
- Construct a southbound right-turn lane on NC 751 with 250 feet of minimum storage;
- Install a traffic signal (subject to MUTCD warrants and approval by NCDOT);
- Construct Site Access #2 with one ingress lane and three egress lanes allowing for dual left-turn lanes and a shared through/ right-turn lane.

With these improvements, the intersection will operate at an acceptable LOS C during the AM peak hour and an acceptable LOS B during the PM peak hour.

NC 751 and Higher Learning Drive

The following table summarizes the LOS and delay for this unsignalized intersection.

| Scenario | AM LOS | PM LOS |
|--------------------------------|--------|--------|
| Existing (2008) | C* | B* |
| No-Build (2016) | C* | B* |
| Build (2016) | E* | C* |
| Build with Improvements (2016) | B* | B* |

* Unsignalized operation, with LOS reported for the worst approach

The analysis indicates that the westbound Higher Learning Drive approach will operate at a LOS C or better with No-Build traffic volumes. With site traffic added, the westbound approach will operate at a LOS E in the AM peak hour. The TIA recommended the following improvements to mitigate congestion:

- Widen NC 751 to provide a median and one additional through lane in each direction.

The analysis indicates that the westbound Higher Learning Drive approach at this location will operate at an acceptable LOS B during both the AM and PM peak hour under future Build with Improvements condition.

NC 751 and Colvard Farms Road (eliminated in the Build scenario)

The following table summarizes the LOS for this unsignalized intersection.

| Scenario | AM LOS | PM LOS |
|--------------------------------|--------|--------|
| Existing (2007) | C* | C* |
| No-Build (2016) | E* | E* |
| Build with Improvements (2016) | N/A | N/A |

* Unsignalized operation, with LOS reported for the worst approach

This existing intersection is proposed to be eliminated in the Build condition.

NC 751 and Site Access #3 (full access)

The following table summarizes the LOS for this unsignalized intersection.

| Scenario | AM LOS | PM LOS |
|--------------------------------|--------|--------|
| Build (2016) | F* | F* |
| Build with Improvements (2016) | B | B |

* Unsignalized operation, with LOS reported for the worst approach

As an unsignalized intersection, the eastbound approach will operate at LOS F with high delays. The TIA recommended the following improvements to mitigate congestion:

- Widen NC 751 to provide one additional through lane in each direction;
- Construct a northbound left-turn lane on NC 751 with 200 feet of minimum storage;
- Construct a southbound right-turn lane on NC 751 with 150 feet of minimum storage;
- Install a traffic signal (subject to MUTCD warrants and approval by NCDOT);
- Construct Site Access #3 with one ingress lane and three egress lanes allowing for dual left-turn lanes and an exclusive right-turn lane.

With these improvements, the intersection will operate at LOS B during peak hours.

NC 751 and Fayetteville Road/ Site Access #4 (full access)

The following table summarizes the LOS for this signalized intersection.

| Scenario | AM LOS | PM LOS |
|--------------------------------|--------|--------|
| Existing (2007) | B | C |
| No-Build (2016) | C | D |
| Build (2016) | F | F |
| Build with Improvements (2016) | D | D |

The analysis indicates that the intersection will operate at a LOS D or better with No-Build traffic volumes. With site traffic added, the intersection deteriorates to a LOS F with very high delays (398 seconds in AM and 1644 seconds in PM). The TIA recommended the following improvements to mitigate congestion:

- Widen NC 751 to provide one additional through lane in each direction;
- Construct a northbound left-turn lane on NC 751 with 250 feet of minimum storage;
- Construct a northbound right-turn lane on NC 751 with 400 feet of minimum storage;
- Construct a southbound right-turn lane on NC 751 with 150 feet of minimum storage;
- Construct Site Access #4 with one ingress lane and four egress lanes allowing for two left-turn lanes, one through lane and a right-turn lane;
- Construct westbound dual left-turn lanes on Fayetteville Road with 300 feet of minimum storage;
- Construct a westbound right-turn lane on Fayetteville Road with 300 feet of minimum storage;
- Re-stripe the current westbound lane on Fayetteville Road as a through lane.

With these improvements, the intersection will operate at an acceptable LOS D during both peak hours.

NC 751 and Site Access #5 (right-in /right-out)

The following table summarizes the LOS and delay for this unsignalized intersection.

| Scenario | AM LOS | PM LOS |
|--------------------------------|--------|--------|
| Build with Improvements (2016) | A* | A* |

* Unsignalized operation, with LOS reported for the worst approach

The analysis indicates that the eastbound approach at this location will operate at an acceptable LOS A during both peak hours with the following improvements:

- Widen NC 751 to provide one additional through lane in each direction. The northbound lane must commence a minimum of 1,000 feet south of the intersection. The additional southbound lane must extend a minimum of 1,200 feet (exclusive of tapers) south of the intersection;
- Construct a southbound right-turn lane on NC 751 with 150 feet of minimum storage;
- Construct Site Access #5 with appropriate channelization and signage to restrict movements to right-in/right-out.

NC 751 and O'Kelly Chapel Road

The following table summarizes the worst-approach LOS for this unsignalized intersection.

| Scenario | AM LOS | PM LOS |
|--------------------------------|--------|--------|
| Existing (2007) | F* | C* |
| No-Build (2016) | F* | F* |
| Build (2016) | F* | F* |
| Build with Improvements (2016) | E | B |

* Unsignalized operation, with LOS reported for the worst approach

The analysis indicates that the westbound approach at this location will operate at a LOS F during the AM and PM peak hours under future No-Build, Build and Build-Improved conditions. The vehicles on the westbound approach would experience an average delay of 255 seconds during the morning commute and 97 seconds during the evening commute with No-Build traffic. With site traffic added, delays on the same approach would increase to 573 seconds in the morning and 553 seconds in the evening. To mitigate this condition, the TIA recommended the following improvements:

- Construct a westbound right-turn lane with 200 feet of minimum storage;
- Construct a southbound left-turn lane with 100 feet of minimum storage;
- Install a traffic signal (subject to MUTCD warrants and approval by NCDOT).

With these improvements, the intersection will operate at a LOS E during the AM peak hour and a LOS B in the PM peak hour. Although the intersection is projected to operate at a LOS E in the AM peak hour, the delay is limited to primarily to the westbound right-turn. To provide a conservative analysis, NCDOT does not permit right-turns on red to be included in the analysis. If right-turns on red were included in the analysis, the expected LOS would improve to an acceptable LOS D in the AM peak hour. Although a LOS E at a signalized intersection is not typically acceptable, this intersection is located within Chatham County, therefore the proposed mitigation requirements were determined solely by NCDOT, and no additional improvements were required to mitigate site traffic.

Fayetteville Road and Renaissance Parkway

The following table summarizes the LOS for this signalized intersection.

| Scenario | AM LOS | PM LOS |
|-----------------|----------|----------|
| Existing (2007) | B | C |
| No-Build (2016) | C | D |
| Build (2016) | C | D |

The analysis indicates that the intersection will operate at acceptable levels of service for all scenarios and traffic conditions. Therefore, no improvements are required.

Fayetteville Road and Massey Chapel Road (north)

The following table summarizes the LOS and delay for this unsignalized intersection.

| Scenario | AM LOS | PM LOS |
|--------------------------------|-----------|-----------|
| Existing (2007) | C* | D* |
| No-Build (2016) | F* | F* |
| Build (2016) | F* | F* |
| Build with Improvements (2016) | C | B |

* Unsignalized operation, with LOS reported for the worst approach

The analysis indicates that the westbound Massey Chapel Road approach will operate at a LOS F during both peak hours in the No-Build scenario. The vehicles on this approach would experience an average delay of 51 seconds during the morning commute and 328 seconds during the evening commute with No-Build traffic. The revised TIA study recommends realignment of Massey Chapel Road and conversion of the two off-set T-intersections with Fayetteville Road into a single four-legged intersection, however only the following short-term solution was proposed for this development:

- Construct a westbound right-turn lane with 200 feet of minimum storage.

With the additional site traffic and the proposed right-turn lane, delays at this intersection would increase to an average of 1,093 seconds in the morning and 1,123 seconds in the evening. Based on the excessive projected delay at this intersection, NCDOT required the following additional improvement:

- Install a traffic signal (subject to MUTCD warrants and approval by NCDOT);
- Construct a northbound right-turn lane with 150 feet of minimum storage.

The installation of a traffic signal will provide safety benefits and reduce the excessive delay. With the proposed improvements, the intersection is expected to operate at an acceptable LOS C or better for both the AM and PM peak hour. However, due to the inadequate spacing between the two Massey Chapel intersections along Fayetteville Road, additional mitigation measures such as the long-term solution mentioned in the TIA, but not committed to by the development, will still be needed at this intersection.

Fayetteville Road and Massey Chapel Road (south)

The following table summarizes the LOS and delay for this unsignalized intersection.

| Scenario | AM LOS | PM LOS |
|--------------------------------|-----------|-----------|
| Existing (2008) | E* | E* |
| No-Build (2016) | F* | F* |
| Build (2016) | F* | F* |
| Build with Improvements (2016) | D | C |

* Unsignalized operation, with LOS reported for the worst approach

The analysis indicates that the eastbound Massey Chapel Road approach will operate at a LOS F during both peak hours in the No-Build scenario. The vehicles on this approach would experience an average delay of 372 seconds during the morning commute and 450 seconds during the evening commute with No-Build traffic. With site traffic added, delays on the same approach would increase to very high levels that cannot be predicted using the Synchro traffic model.

The revised TIA study recommends realignment of Massey Chapel Road and conversion of the two off-set T-intersections with Fayetteville Road into a single four-legged intersection, however only the following short-term solutions were proposed for this development:

- Construct an eastbound right-turn lane with 200 feet of minimum storage;
- Install a traffic signal (subject to MUTCD warrants and approval by NCDOT).

The installation of a traffic signal will provide safety benefits and reduce the excessive delay. With the proposed improvements, the intersection is expected to operate at an acceptable LOS D or better for both the AM and PM peak hour. However, due to the inadequate spacing between the two Massey Chapel intersections along Fayetteville Road, additional mitigation measures such as the long-term solution mentioned in the TIA, but not committed to by the development, will still be needed at this intersection.

Fayetteville Road and Scott King Road

The following table summarizes the LOS and delay for this unsignalized intersection.

| Scenario | AM LOS | PM LOS |
|--------------------------------|-----------|-----------|
| Existing (2007) | B* | B* |
| No-Build (2016) | C* | C* |
| Build (2016) | F* | F* |
| Build with Improvements (2016) | F* | F* |

* Unsignalized operation, with LOS reported for the worst approach

The analysis indicates that the westbound Scott King Road approach will operate at a LOS C during both peak hours with No-Build traffic volumes and the following committed improvements from the Jordan at Southpoint development:

- A southbound left-turn lane with 100 feet of minimum storage;
- A westbound right-turn lane with 100 feet of minimum storage.

With site traffic added, the westbound approach decreases to a LOS F with 147 seconds of average delay per vehicle in the morning peak hour and 98 seconds in the evening peak hour. The TIA recommended the following improvement:

- Construct a northbound right-turn lane with 100 feet of minimum storage;
- Extend the westbound right-turn lane to provide 300 feet of minimum storage.

The westbound approach will continue to operate at a LOS F with the proposed improvements. Although a LOS F is undesirable at signalized intersections, a LOS F is typical at many unsignalized intersections during a peak hour until such time as a traffic signal is warranted. A traffic signal was not recommended at this intersection due to the inadequate intersection spacing from the existing traffic signal at NC 751 and Fayetteville Road.

Massey Chapel Road/ Barbee Road and Herndon Road

The following table summarizes the LOS for this unsignalized intersection.

| Scenario | AM LOS | PM LOS |
|--------------------------------|-----------|-----------|
| Existing (2008) | C* | F* |
| No-Build (2016) | F* | F* |
| Build (2016) | F* | F* |
| Build with Improvements (2016) | B | C |

* Unsignalized operation, with LOS reported for the worst approach

The analysis indicates that the southbound Herndon Road approach at this location will operate at a LOS F during both peak hours under future No-Build and Build conditions. The vehicles on the southbound approach would experience an average delay of 68 seconds during the morning commute and 681 seconds during the evening commute with No-Build traffic. With site traffic added, delays on the same approach would increase to 352 seconds in the morning and unusually high (unpredictable) in the evening. To mitigate this condition, the original TIA recommended the following improvements:

- Install a traffic signal (subject to MUTCD warrants and approval by NCDOT); or
- Construct a roundabout (as an alternative to signalization and to promote traffic calming while ensuring adequate traffic capacity).

With either of these improvements, the southbound approach delay would improve, and the intersection would operate at a LOS C or better if signalized and at a volume-to-capacity ratio of 0.54 with a roundabout.

Barbee Road and Grandale Road

The following table summarizes the LOS for this unsignalized intersection.

| Scenario | AM LOS | PM LOS |
|--------------------------------|--------|--------|
| Existing (2008) | C* | C* |
| No-Build (2016) | D* | F* |
| Build (2016) | E* | F* |
| Build with Improvements (2016) | C* | E* |

* Unsignalized operation, with LOS reported for the worst approach

The analysis indicates that the stop-controlled northbound Grandale Road approach will operate at a LOS F during the PM peak hour with No-Build and Build traffic volumes. The TIA recommended the following improvement:

- Construct a northbound right-turn lane with 150 feet of minimum storage.

With this improvement, the northbound approach will improve to LOS E during the PM peak hour. Although a LOS E is undesirable at signalized intersections, a LOS E or LOS F is typical at many unsignalized intersections during a peak hour until such time as a traffic signal is warranted. Given the existing intersection spacing from the Barbee Road/Massey Chapel Road and Herndon Road intersection, a traffic signal is not recommended for this location.

Scott King Road and Herndon Road

The following table summarizes the LOS for this unsignalized intersection.

| Scenario | AM LOS | PM LOS |
|-----------------|--------|--------|
| Existing (2007) | A* | A* |
| No-Build (2016) | B* | A* |
| Build (2016) | B* | B* |

* Unsignalized operation, with LOS reported for the worst approach

The analysis indicates that all movements will operate at acceptable levels of service for all scenarios and time periods. Therefore, no improvements are required.

Summary of TIA Required Improvements

General

1. Upgrade existing signal heads and timing plans to accommodate the recommended improvements at all signalized intersections.
2. Provide a signal warrant analysis and install a traffic signal (or roundabout) if warranted and approved by NCDOT prior to full build-out for the following intersections:
 - a. NC 751 and Massey Chapel Road;
 - b. Stagecoach Road and Farrington Road;
 - c. NC 751 and Student Place/Site Access #2;
 - d. NC 751 and Site Access #3;
 - e. NC 751 and O'Kelly Chapel Road;
 - f. Fayetteville Road and Massey Chapel Road (north);
 - g. Massey Chapel Road/Barbee Road and Herndon Road;
 - h. Fayetteville Road and Massey Chapel Road (south).
3. Widen NC 751 to a four-lane divided cross-section from south of site access #5 to north of Stagecoach Road to provide two through lanes with outside bike lanes in each direction.
4. Reduce the speed limit on NC 751 for the proposed widening area from 55 mph to 45 mph, due to the change in the nature of the roadway environment with this development (subject to approval by NCDOT).
5. Acquire and dedicate additional right-of-way as necessary to construct all required off-site roadway improvements.

NC 751 and I-40 Westbound Ramps

1. Construct an additional westbound right-turn lane with adequate storage and taper.

NC 751 and I-40 Eastbound Ramps

1. Restripe southbound approach to provide dual left-turn lanes with adequate storage and taper.
2. Widen the I-40 Eastbound On-Ramp to accommodate a second receiving lane, tapering back to a single lane prior to its merge with I-40 Eastbound.
3. Extend the outer eastbound right-turn lane to provide adequate storage and taper.

NC 751 and Renaissance Parkway

1. Extend the existing southbound through lane as a second through lane south of the intersection with adequate storage and appropriate tapers.

NC 751 and Massey Chapel Road

1. Construct a westbound right-turn lane with adequate storage and taper.

NC 751 and Stagecoach Road

1. Widen NC 751 to provide two through lanes and a bicycle lane in each direction. The additional lanes must extend north of the intersection to provide adequate storage and tapers.
2. Construct a northbound left-turn lane with adequate storage and taper.

Stagecoach Road and Farrington Road

1. Construct a westbound right-turn lane with adequate storage and taper.
2. Construct a northbound right-turn lane with adequate storage and taper.

NC 751 and Student Place/ Site Access #2

1. Widen NC 751 to provide two through lanes and a bicycle lane in each direction.
2. Construct a southbound right-turn lane with adequate storage and taper.
3. Construct a northbound left-turn lane with adequate storage and taper.
4. Construct Site Access #2 to accommodate one ingress lane and three egress lanes allowing for dual left-turn lanes and a shared through/ right-turn lane.

NC 751 and Higher Learning Drive

1. Widen NC 751 to provide two through lanes, a median, and a bicycle lane in each direction.

NC 751 and Site Access #3

1. Widen NC 751 to provide two through lanes and a bicycle lane in each direction.
2. Construct a southbound right-turn lane with adequate storage and taper.
3. Construct a southbound left-turn lane with adequate storage and taper.
4. Construct a northbound left-turn lane with adequate storage and taper.
5. Construct Site Access #3 to accommodate one ingress lane and three egress lanes allowing for dual left-turn lanes and an exclusive right-turn lane.

NC 751 and Fayetteville Road/ Site Access #4

1. Widen NC 751 to provide two through lanes and a bicycle lane in each direction.
2. Construct a southbound right-turn lane with adequate storage and taper.
3. Construct a northbound left-turn lane with adequate storage and taper.
4. Construct a northbound right-turn lane with adequate storage and taper.
5. Construct dual westbound left-turn lanes with adequate storage and taper.

6. Construct a westbound right-turn lane with adequate storage and taper.
7. Construct Site Access #4 to accommodate one ingress lane and four egress lanes allowing for dual left-turn lanes, a through lane, and exclusive right-turn lane.

NC 751 and Site Access #5

1. Widen NC 751 to provide two through lanes and a bicycle lane in each direction. The additional lanes must extend south of the intersection to provide adequate storage and tapers.
2. Construct a southbound right-turn lane with adequate storage and taper.
3. Construct Site Access #5 with appropriate channelization and signage to restrict movements to right-in/right-out.

NC 751 and O'Kelly Chapel Road

1. Construct a westbound right-turn lane with adequate storage and taper.
2. Construct a southbound left-turn lane with adequate storage and taper.

Fayetteville Road and Massey Chapel Road (North)

1. Construct a westbound right-turn lane with adequate storage and taper.
2. Construct a northbound right-turn lane with adequate storage and taper.

Fayetteville Road and Massey Chapel Road (South)

1. Construct an eastbound right-turn lane with adequate storage and taper.

Fayetteville Road and Scott King Road

1. Construct a southbound left-turn lane with adequate storage and taper.
2. Construct a westbound right-turn lane with adequate storage and taper.
3. Construct a northbound right-turn lane with adequate storage and taper.

Barbee Road and Grandale Drive

1. Construct a northbound right-turn lane with adequate storage and taper.